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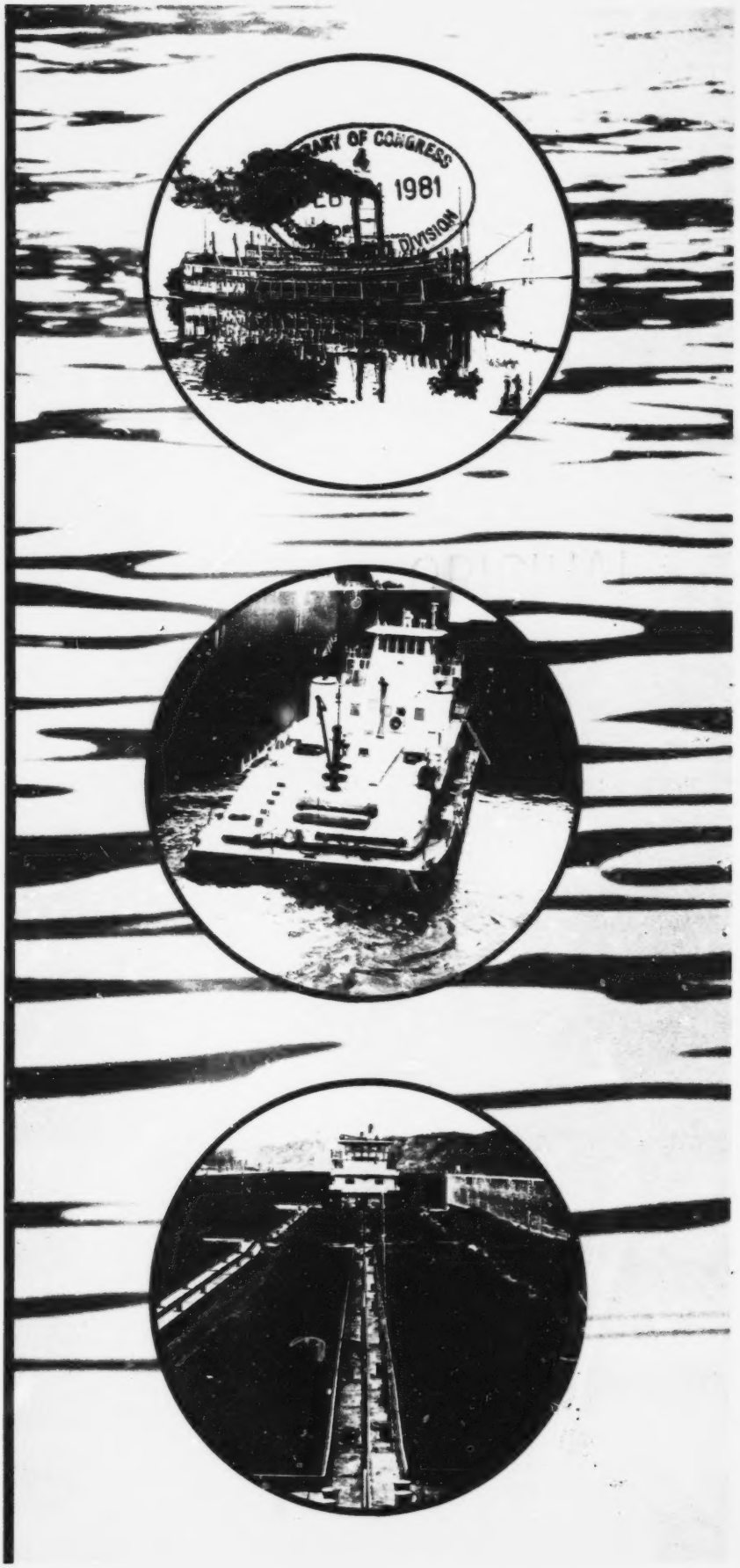
Projections Of Demand For Waterborne Transportation

Ohio River Basin
1980 - 2040

Volume 12

Wood and Paper Products



U. S. Army Corps of Engineers
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Cincinnati, Ohio

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Projections of Demand for Waterborne Transportation, Ohio River Basin 1980, 1990, 2000, 2020, 2040; Vol. 12, Group X: Wood and Paper Products

5. TYPE OF REPORT & PERIOD COVERED
Vol. 12 of 17

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

8. CONTRACT OR GRANT NUMBER(s)
DACW69-78-C-0136

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Robert R. Nathan Associates, Inc.
Consulting Economists
1301 Pennsylvania Ave., N.W.
Washington, DC 20004

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
Ohio River Basin Navigation Studies

11. CONTROLLING OFFICE NAME AND ADDRESS
U.S. Army Corps of Engineers, Ohio River Div.
ATTN: Navigation Studies Branch, Planning Div.
P.O. Box 1159, Cincinnati, OH 45201

12. REPORT DATE
December 1980

13. NUMBER OF PAGES
61

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
U.S. Army Corps of Engineers, Huntington District
P.O. Box 2127
Huntington, WV 25721

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for Public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Cont on reverse side if necessary and identify by block number)

Bulk cargo	Market demand analysis	Wood
Commodity resource inventory	Modal split analysis	Wood products
Economic development	Ohio River Basin	Paper products
Economic forecasting	River basin development	
Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

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(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 12 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title	
1	Study summary	
2	Methodology	
3	Group I:	Coal and coke
4	Group II:	Petroleum fuels
5	Group III:	Crude Petrol.
6	Group IV:	Aggregates
7	Group V:	Grains
8	Group VI:	Chemicals and chemical fertilizers
9	Group VII:	Ores and Minerals
10	Group VIII:	Iron ore, steel and iron
11	Group IX:	Feed and food products, nec.
12	Group X:	Wood and paper products
13	Group XI:	Petroleum products, nec.
14	Group XII:	Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII:	Nonferrous, metals and alloys, nec.
16	Group XIV:	Manufactured products, nec.
17	Group XV:	Other, nec.

Additionally, an Executive Summary is available as a separate document.

Volume 12 of 17

GROUP X :
WOOD AND PAPER PRODUCTS

PROJECTIONS OF DEMAND
FOR
WATERBORNE TRANSPORTATION
OHIO RIVER BASIN
1980, 1990, 2000, 2020, 2040

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

DECEMBER 1980

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Library cataloging information:

Robert R. Nathan Associates, Inc.
Projections of demand for waterborne transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040 / Prepared for the U.S. Army Corps of Engineers, Huntington District ... by Robert R. Nathan Associates, Inc., December 1980.
Cincinnati, Ohio : U.S. Army Corps of Engineers, Ohio River Division, 1980.
17 v. : ill. ; 28 cm.
Contract DACW69-78-0136.
"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

1. Shipping--Ohio River Basin. 2. Inland water transportation--Ohio River Basin--Statistics. 3. Ohio River Basin. I. United States. Army. Corps of Engineers. Ohio River Division. II. United States. Army. Corps of Engineers. Huntington District. III. Title.

HE597.03N3 OCLC no. 7030444

PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
Group VIII: Iron Ore, Steel and Iron	104	10
Group IX: Feed and Food Products, Nec.	44	11
Group X: Wood and Paper Products	61	12
Group XI: Petroleum Products, Nec.	38	13
Group XII: Rubber, Plastic, Nonmetallic Mineral Products, Nec.	41	14
Group XIII: Nonferrous Metals and Alloys, Nec.	57	15
Group XIV: Manufactured Products Nec.	35	16
Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Group X: Wood and Paper Products

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

VII

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I. INTRODUCTION

Group X, wood and paper products, consists of forest products ranging from wood logs and furniture to paper and printed products. During the 1969-76 period, these products accounted for an average of only 0.4 percent of total Ohio River System (ORS) traffic. The bulk of this was local movement.

The areas within the Ohio River Basin (ORB) for which projections of Group X consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group X are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group X waterborne movements. A map showing Group X PSAs is presented in the appendix to this report.

In addition to the PSAs, external areas linked to the ORB through waterborne commerce have been identified. Areas (BEAs) outside the ORB which are destinations of waterborne Group X movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group X waterborne movements destined to the ORB are designated as Secondary Production Areas (SPAs).

A. Description of Group X

The individual products included in Group X are:

Waterborne Commerce Statistics Code (WCSC)	Product
2411	Logs
2412	Rafted logs

2413	Fuelwood, charcoal and wastes
2415	Timber, posts, poles, piling and other wood in the rough
2415	Pulpwood logs
2416	Wood chips, staves, molding, and excelsior
2421	Lumber
2431	Veneer, plywood, and other worked wood
2491	Wood manufacturers, not elsewhere classified (nec.)
2451	Furniture and fixtures
2611	Pulp
2621	Standard newsprint paper
2631	Paper and paperboard
2691	Pulp paper and paperboard products, nec.
0861	Forest products, nec.

Historical data and discussions with industrial authorities indicate that only six products within Group X may be expected to generate significant future waterborne traffic flows in the ORS. These products can be classified into three product categories:

- Pulpwood logs (WCSC 2415)
- Lumber products (WCSC 2421)
- Paper products (WCSC 2611, 2621, 2631 and 2691).

In the 1969-76 period, these three categories of products accounted for between 94 and 99 percent of total wood and paper products movement in the ORS. Other wood and paper products,

including WCSCs 2411, 2412, 2414, 2416, 2431, 2491, and 0861, generated only random and small movements in the 1969-76 period. In 1976, with the exception of logs (WCSC 2411), none of these products recorded any waterborne movements, and it is not anticipated that any of them will move by water in significant quantities in the future.

B. Existing Waterway Traffic Flows

The total inbound, outbound and local wood and paper products traffic in the ORS was recorded at about 500 thousand tons in 1969. It increased to the peak level of 600 thousand tons in 1972 and dropped to 566.7 thousands tons in 1976 (Table 1). In 1976, wood and paper products accounted for only 0.3 percent of all waterborne shipments in the ORS (Table 2).

B-1. BEA-to-BEA Traffic Flows

From 1969 to 1976, waterborne shipments of Group X products from one port equivalent (PE) to another within the Ohio River System (i.e., local traffic) increased at a rate of 6.9 percent per annum. Inbound and outbound traffic, from or to points outside the ORB, experienced fluctuating, but generally decreasing, trends. In 1976, 515.3 of the 566.5 thousand tons of wood and paper products transported by water in the Ohio River System were local shipments (Table 1). Overall, the bulk of Group X traffic consists of local movements.

BEA 47 (Huntsville) recorded waterborne shipments of wood and paper products amounting to 402.9 thousand tons in 1976. This was the largest waterborne tonnage originating from any PSA in 1976, accounting for almost three-fourths of all waterborne ORS wood and paper products shipments (Table 3). BEA 47 shipments included 214.8 thousand tons of pulpwood logs moved to paper mills in BEA 48 (Chattanooga) and 91.3 thousand tons of paper products transported to a waterside railroad terminal in BEA 47 for distribution to destinations within the BEA.

BEA 48 was another important origin of waterborne wood and paper product movements in 1976. It accounted for 77.9 thousand tons or 14 percent of waterborne ORS wood and paper product shipments (Table 3). Almost 90 percent of BEA 48 shipments was pulpwood logs, and the remainder consisted of newsprint and paper products.

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Table 1. Ohio River System: Waterborne Shipments of Wood and Paper Products, by Product, Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons)

Product and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total[a]	501.1	508.0	555.2	600.7	589.5	564.4	503.5	566.7[b]	1.8
Inbound	71.8	80.5	34.5	45.8	46.5	39.7	3.9	8.8	(25.9)
Outbound	106.3	110.5	124.1	101.3	74.4	66.4	95.1	42.6[b]	(12.2)
Local	322.9	317.1	396.5	453.7	468.6	458.3	404.5	515.3	6.9
Logs	8.4	4.9	9.9	8.5	6.7	15.8	24.1	33.7[b]	22.0
Inbound	--	0.3	--	--	--	--	--	--	--
Outbound	8.3	4.6	9.9	8.5	6.7	15.8	24.1	33.7[b]	22.2
Local	0.1	--	--	--	--	--	--	--	--
Rafted logs	0.2	--	--	--	--	--	--	--	--
Inbound	--	--	--	--	--	--	--	--	--
Outbound	0.2	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--
Timber, posts, poles	4.0	2.5	1.6	--	--	--	--	--	--
Inbound	3.7	1.5	--	--	--	--	--	--	--
Outbound	--	0.4	--	--	--	--	--	--	--
Local	0.3	0.6	1.6	--	--	--	--	--	--
Pulpwood logs	311.2	306.9	313.1	336.9	350.4	303.0	278.0	327.2	0.7
Inbound	--	--	--	--	--	--	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	311.2	306.9	313.1	336.9	350.4	303.0	278.0	327.2	0.7
Wood chips, staves	2.1	0.8	--	1.9	0.6	--	--	--	--
Inbound	2.1	0.8	--	1.9	0.6	--	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--

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Table 1 (Continued)

Product and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Lumber	4.5	11.7	33.4	36.9	29.6	34.6	24.7	28.9	30.4
Inbound	4.1	11.7	3.6	4.4	4.2	1.0	--	--	--
Outbound	--	--	--	--	1.0	--	--	--	--
Local	0.4	--	29.8	32.5	24.4	33.6	24.7	28.9	84.3
Veneer, plywood	4.9	3.0	1.1	2.3	0.7	1.2	--	--	--
Inbound	4.9	3.0	1.1	2.3	0.7	1.2	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--
Wood manufactures	1.2	0.1	--	0.1	0.4	--	--	--	--
Inbound	1.2	0.1	--	c	0.4	--	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	c	--	0.1	--	--	--	--	--
Pulp	--	1.1	19.5	52.5	65.1	79.9	48.7	69.0	d
Inbound	--	1.1	--	15.3	25.8	28.8	--	1.1	d
Outbound	--	--	1.1	3.6	--	--	6.6	--	--
Local	--	--	18.4	33.6	39.3	51.1	42.1	67.9	d
Standard newsprint paper	121.7	125.5	139.5	106.2	70.3	34.1	44.7	5.6	(35.6)
Inbound	13.7	15.6	21.4	16.9	8.7	2.5	1.2	--	--
Outbound	97.1	100.4	110.5	84.4	60.6	30.4	41.0	5.6	(35.5)
Local	10.9	9.5	7.6	4.9	1.0	1.2	2.5	--	--
Paper and paperboard	41.9	48.9	36.9	54.5	64.8	95.8	83.3	102.3	13.6
Inbound	41.2	43.7	8.4	4.9	6.1	6.2	2.7	7.7	(21.3)
Outbound	0.7	5.2	2.5	4.0	5.2	20.2	23.4	3.3	24.8
Local	--	--	26.0	45.6	53.5	69.4	57.2	91.3	d

(Continued)

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Table 1 (Continued)

Product and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Pulp, paper products	1.0	--	--	0.8	0.8	--	--	--	--
Inbound	0.9	--	--	--	--	--	--	--	--
Outbound	--	--	--	0.8	0.8	--	--	--	--
Local	0.1	--	--	--	--	--	--	--	--
Forest products	--	2.6	--	--	--	--	--	--	--
Inbound	--	2.6	--	--	--	--	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--

Note: Individual items may not add to totals due to rounding.

a. Excludes waterborne commodity code no. 2511 (furniture and fixtures) and 2711 (printed matter) for which no waterborne movements were reported.

b. Includes 2.7 thousand tons transshipped via BEA 62 from BEA 107 to BEA 138.

c. Less than 50 tons.

d. No movements in 1969.

Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

Table 2. Ohio River System: Waterborne Shipments of All Commodities and of Wood and Paper Products, 1976

(Thousands of tons unless otherwise specified)

	Total	Inbound	Outbound	Local
All commodities	200,771.8	29,440.7	26,827.7	144,503.4
Wood and paper products	566.7	8.8	42.6[a]	515.3
As a percentage of all commodities	0.3	b	0.2	0.4

a. Includes 2.7 thousand tons transshipped from BEA 107 to BEA 138 via BEA 62.

b. Less than .05 percent.

Source: Compiled by RRNA from U.S. Army Corps of Enginners, Waterborne Commerce by Port Equivalents, revised 1976.

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Table 3. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group 10: Wood and Paper Products
(Thousands of tons)

Origin	Destination											
	Total	ORB BEAs	BEA 47	BEA 48	BEA 62	BEA 66	Non-ORB BEAs	BEA 107	BEA 114	BEA 115[a]	BEA 138	BEA 144
Total	566.7	524.1	188.1	327.2	1.0	7.8	42.6	1.1	1.1	4.5	29.2	6.7
ORB BEAs	557.9	515.3	188.1	327.2	--	--	42.6	1.1	1.1	4.5	29.2	6.7
BEA 47	402.9	402.9	188.1	214.8	--	--	--	--	--	--	--	--
BEA 48	77.9	69.0	--	69.0	--	--	8.9	1.1	1.1	--	--	6.7
BEA 50	43.4	43.4	--	43.4	--	--	--	--	--	--	--	--
BEA 54	2.2	--	--	--	--	--	2.2	--	--	--	2.2[b]	--
BEA 62	27.0	--	--	--	--	--	27.0	--	--	--	27.0[b]	--
BEA 115	4.5	--	--	--	--	--	4.5	--	--	4.5	--	--
Non-ORB BEAs	8.8	8.8	--	--	1.0	7.8						
BEA 117	1.1	1.1	--	--	--	1.1	**Traffic external to Ohio River System**					
BEA 135	6.7	6.7	--	--	--	6.7						
BEA 138	1.0	1.0	--	--	1.0	--						

a. Consists of counties external to Ohio River Basin.
b. Includes 2.7 thousand tons transshipped from BEA 107 to BEA 138 via BEA 62.
Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

Other BEAs contributed relatively insignificant amounts of wood and paper products to ORS waterborne traffic. BEA 50 (Knoxville) shipped 43.4 thousand tons of pulpwood logs, but all other PSAs, combined, accounted for less than 6 percent of the total waterborne movements of wood and paper products in the Ohio River System.

B-2. Highlights of Important Links

Not only do most waterborne movements of Group X occur between PEs within the ORB (local movements), but most of these movements are between BEAs 47 (Huntsville) and 48 (Chattanooga). The Tennessee River is the origin as well as destination of nearly all wood and paper product shipments (Table 4). Other (small) local movements originate from, and are destined for, docks on the Ohio and Monongahela Rivers.

a. Local movements

Pulpwood logs constitute the major part of local movements. Logs are shipped to the river by truck from the fertile forests in the Tennessee Valley along the Tennessee River. These movements are stimulated by a large number of pulp and paper mills in Tennessee and northern Alabama. Some mills, such as Mead Corporation, in Stevenson, and Champion Paper, in Courtland, Alabama, are able to produce as much as a quarter-million tons of paper products per year.

Although most of the pulpwood logs used as inputs in ORB paper mills are transported from the forest to the mill directly by truck, they nevertheless accounted for 64 percent of local and 58 percent of total waterborne wood and paper product shipments in the ORB in 1976. Guntersville, Alabama, has been a main shipment point for BEA 47, the largest origin of pulpwood log shipments. Other points along the Tennessee and Clinch/Emory Rivers also have had significant shipments.

All other products together account for approximately one-third of total local waterborne movements of wood and paper products. Most are shipped on the Tennessee River, for only short distances, to a railroad terminal near the Wheeler pool.

b. Inbound Movements

There have been no recorded major inbound waterborne shipments of wood and paper products in recent years. Newsprint and paperboard are shipped to the ORB from BEA 135 (Jackson) and BEA 138

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Table 4. Ohio River System: Major River Origins and Destinations of Wood and Paper Product Waterborne Movements, 1976

(Thousands of tons)

River origin and destination	Total	Logs (2411)[a]	Pulpwood logs (2415)[a]	Lumber (2421)[a]	Paper products (2611, 2621, 2631, 2691)[a]
ORB origins:					
Total	557.9	33.7	327.2	28.9	168.1
Ohio River	33.7	33.7	--	--	--
Tennessee River	524.2	--	327.2	28.9	168.1
ORB destinations:					
Total	524.1	--	327.2	28.9	168.0
Ohio River	2.1	--	--	--	2.1
Tennessee River	515.3	--	327.2	28.9	159.2
Monongahela River	6.7	--	--	--	6.7

a. Waterborne Commerce Statistics Code.

Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

(Baton Rouge). However, inbound shipments of these products decreased from 60 thousand tons in 1969 and 1970 to 30 thousand tons in 1971 and continued on a downward trend until 1976. A paper shortage during the 1972-74 period caused some imported pulp to be shipped to the ORS via the Mississippi River (29 thousand tons in 1974), but this was only a temporary boost in inbound shipments. In 1975 and 1976, total inbound traffic accounted for less than 2 percent of total ORS waterborne movements of wood and paper products.

c. Outbound Movements

In the past decade, nearly all outbound waterborne shipments of wood and paper products have been standard newsprint. These shipments are made from paper-producing areas in BEAs 47 (Huntsville) and 48 (Chattanooga) to destinations in BEA 138 (New Orleans) for export. In recent years, these outbound shipments have been steadily decreasing as areas in the northern and eastern states have successfully competed to purchase paper products from the areas served by the ORS. In 1976, only 5.6 thousand tons of newsprint paper were shipped outbound via the Tennessee and Mississippi Rivers.

d. Intermodal Transfers

Between 1969 and 1976, three thousand tons of logs were trucked to Cincinnati from Iowa. They were then transferred onto barges for export. This was a long and costly truck haul. It, undoubtedly, represented a short-term practice which was too uneconomical to continue. Other intermodal transfers include barge/rail transfers near Wheeler pool, discussed above.

C. Summary of Study Findings

The consumption of wood and paper products in the Primary Study Areas increased from 11 million tons in 1969 to over 13 million tons in 1976, approximately a 20 percent increase. Production also increased 20 percent in the same 1969-76 period, reaching 5.8 million tons in 1976. In the future, consumption is expected to grow at a somewhat higher rate than production. By 2040, while production of wood and paper products in the PSAs is expected to be 21 million tons, consumption will be approximately 59 million tons.

The relative contribution of each of the PSAs to consumption and production of Group X products in the area served by the ORS is expected either to change very little or to remain the same as in

1976. BEAs 47 (Huntsville) and 48 (Chattanooga) will continue to be major production areas, while BEAs 47 and 50 (Knoxville) are expected to remain major consumption areas.

The large production/consumption gap in the area served by the ORS undoubtedly will require greater movement of wood and paper products into the area. However, most of the movements are not expected to be waterborne. In the 1976-2040 period, inbound, outbound and local waterborne movements of wood and paper products are expected to grow at average annual rates of 2.3 percent, 2.8 percent and 1.3 percent, respectively. Gross waterborne movements are projected to grow 1.5 percent per year, reaching 1.4 million tons in 2040.

II. MARKET DEMAND ANALYSIS

Consumption of wood and paper products in the PSAs has increased substantially in the past decade. The growing paper industry is a large consumer of pulpwood logs, and increasing amounts of lumber and paper products are needed to satisfy demand generated by growing population and income in the PSAs.

A. Market Areas

In addition to local demand for Group X commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of waterborne wood and paper product movements originating in the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified seven BEAs and BEA segments in the ORB which either have been or will be the ultimate origins or destinations of waterborne wood and paper product movements. Appendix Table A-1 presents the BEAs and BEA segments which constitute the PSAs for wood and paper products, and for which wood and paper product consumption has been analyzed and projected.

Because a large portion of waterborne wood and paper products movements is from or to the Tennessee River, virtually all of the counties in BEAs 47 and 48 stimulate waterway traffic. Therefore, consumption of wood and paper products has been analyzed and projected for the whole of each of these two BEAs. For all other BEAs, consumption was analyzed and projected only for county segments.

A-2. Secondary Consumption Areas (SCAs)

BEAs outside the Ohio River Basin which are destinations of waterborne shipments from the ORB were not segmented, nor was any attempt made to analyze or project consumption in these BEAs. Such efforts were not warranted because historical and projected shipment volumes from the ORB to Secondary Consumption Areas were low. Waterborne shipments from the PSAs to SCAs were projected on the basis of projections of PSA production and consumption as well as the historical relationship of the SCAs to the area served by the ORS.

B. Product Uses

The uses of wood and paper products vary widely among individual products. Generally, lumber is used in the construction and manufacturing industries, while pulpwood logs are used to produce woodpulp and paper. Paper products are used for various purposes, ranging from paper as an intermediate product in the printing and publishing industries to household tissues.

B-1. Lumber

Approximately four-fifths of the lumber consumed in the United States is softwood lumber. In recent years, from one-third to one-half of softwood lumber has been consumed by the residential construction industry. Hardwoods are used primarily in the manufacture of furniture and in the transportation industries for railroad crossties, wood pallets and containers. Table 5 shows the consumption of lumber, by end-use, in the United States in 1970.

B-2. Pulpwood Logs

While lumber is used for various purposes, pulpwood logs are almost exclusively used for the production of paper products. Some pulpwood logs are used as poles in coal mines in eastern Kentucky. However, in the PSAs of the ORB, pulpwood logs are used only in the manufacture of woodpulp and paper products.

B-3. Paper Products

Paper products can be grouped into three separate categories: paper, paperboard and building board. Paper and paperboard account

Table 5. United States: Consumption of Lumber Products, by End Use 1970

End use	Million feet	Percent
Total	39,500	100.0
New housing	12,270	31.1
Residential upkeeps	4,690	11.9
New non-residential construction	3,690	9.3
Manufacturing	4,670	11.8
Shipping	5,720	14.5
All other uses	8,460	21.4

Source: U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources - An Assessment, 1975 ed., p. 147.

for nearly all consumption of paper products. They include newsprint paper, book paper, writing and related papers, packaging paper, kraft linerboard and various other paper products. Their uses are self-descriptive. Building board includes insulation board and hardboard which are used in the construction and housing industries.

C. Consumption Characteristics

Consumption characteristics of wood and paper products are determined by factors influencing product demand. These include product prices, income and population, availability of product substitutes, changes in consumption patterns resulting from technological developments and geographical factors.

C-1. Lumber

Income and population appear to be the most significant factors influencing the demand for lumber products. Because lumber is an intermediate product, its demand is derived from the demand for final products. Higher income and population tend to stimulate higher demands for housing, furniture and other manufactured products. These demands, in turn, increase the demand for lumber used in construction and housing upkeep as well as in manufacturing and transportation.

It is important to note that the average size and age of families also has an important effect on the demand for lumber products. Household heads in the middle age groups tend to have larger families and relatively high incomes. These families typically occupy single family units. Multi-family units and mobile homes, which require significantly less lumber and wood products for construction, tend to be occupied by younger, lower income families.

Another factor affecting the demand for lumber is the price of lumber relative to the price of products which might be substituted for lumber. In the short run, technological constraints make it difficult for lumber users to reduce consumption in the event of price increases. As a result, the short-run demand for lumber is price inelastic.

However, in the long run persistent increases in the relative price of lumber encourage the development of substitutable materials, causing a reduction in the demand for lumber. A U.S. Department of Agriculture study found that:

> Despite the very large expansion of major markets in construction, manufacturing, and shipping during the

> present century, lumber consumption in 1970 approximated the consumption level of the early 1900s. Presumably the increase in relative lumber prices -- averaging 1.6 percent per year in this period --was an important factor leading to increased use of substitutes and other changes affecting lumber uses.[1]

On a regional basis, geographical factors can significantly affect the lumber demand. For example, the lack of economical transport modes can increase the gap between producer prices and the price which consumers actually pay for lumber. Lumber prices will be high relative to prices of other raw materials in the region and will reduce the consumption of lumber products.

C-2. Pulpwood Logs

The demand for pulpwood logs is determined by the production of, and the demand for, paper products. Therefore, most of the factors which influence the production and consumption of paper products (discussed below) also will affect the demand for pulpwood logs. Other things being equal, the demand for pulpwood logs is also influenced by changes in paper production technology (e.g., an increase in various types of fibrous materials used in the manufacture of paper products). During the period from 1950 to 1972, new woodpulp consumption per ton of paper products produced increased from 64 percent of the mix to 80 percent.[2] Waste paper usage, on the other hand, declined substantially.[2] In recent years, environmental concerns and the higher cost of pulpwood production have restrained the demand for pulpwood.

C-3. Paper Products

Paper products consumption in the United States is strongly influenced by population size and per capita income, the effects of which can be approximated by the U.S. Gross National Product (GNP). A recent study conducted by the Stanford Research Institute for the U.S. Department of Commerce shows that, for the 1955-74 period, the variation in GNP explains more than 94 percent of the variations in the consumption of six out of nine paper product commodities.[3]

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1. U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources - An Assessment, 1975 ed. (Washington, D.C.: GPO, 1977) p. 155.
2. Ibid., p. 152.
3. U.S. Department of Commerce, data on files.

Some substitution of other products for paper products has taken place (e.g., plastic bags and cups and foam cups). Metal containers are commonly used in shipping. In the future, computers might substitute for text books. Generally, however, low cost paper product substitutes are not as readily available as are substitutes for other products in Group X. The long-term demand for paper products is, therefore, less price elastic than the demand for other products in this group.

D. Existing Aggregate Demands

The demand for wood and paper products in the ORB has followed the national trend of the past decade. The growth in uses for pulpwood logs and paper products was moderate, while consumption of lumber was cyclical (Table 6).

D-1. Lumber

The total consumption of lumber in the PSAs increased from 2.75 million tons in 1969 to 2.86 million tons in 1976 (Table 7). Lumber consumption tends to be concentrated in well-populated regions, such as the metropolitan areas of Cincinnati and Louisville. A notable exception is BEA 48 (Chattanooga). While not densely populated, this BEA consumed 650 thousands tons of lumber in 1976 and was the second largest consumer among all PSAs. This is because BEA 48 is composed of a large number of counties where furniture and wood production are important.

There has been no significant Secondary Consumption Area (SCA) for lumber products in recent years. Throughout the 1969-76 period, outbound waterborne shipments of lumber from the ORB were negligible.

D-2. Pulpwood Logs

The consumption of pulpwood logs in the PSAs varies directly with the number and size of local pulp and papermills. The large paper production capacity of mills located in Counce, Tennessee and in Courtland, Alabama have made BEA 47 the largest pulpwood consuming PSA (Table 8). The counties located along the Tennessee River provide a good mix of hardwood and softwood tree species which are desirable for paper products production. Together with the availability of clean water from the river, the Tennessee Valley is an optimum location of paper and pulp mills. Therefore, BEAs and BEA segments in the Valley are important consuming areas for pulpwood logs.

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Table 6. Ohio River Basin: Consumption of Wood and Paper Products,[a] by BEAs or BEA Segments,[b] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	11,019.0	11,232.0	11,971.7	12,836.9	11,860.6	14,365.0	13,701.0	13,247.6
BEA 47: Huntsville, AL	2,875.4	2,956.4	3,146.0	3,412.4	3,385.1	3,680.4	3,636.9	3,605.4
BEA 48: Chattanooga, TN	2,283.0	2,324.2	2,484.7	2,678.8	2,668.5	2,801.5	2,734.8	2,787.7
BEA 50: Knoxville, TN	1,918.1	1,979.0	2,101.3	2,280.8	2,262.7	3,356.5	3,207.5	2,416.7
BEA 54: Louisville, KY	895.4	889.9	956.7	1,000.7	1,021.1	929.4	831.7	974.6
BEA 62: Cincinnati, OH	1,943.7	1,970.1	2,099.1	2,224.8	2,253.3	2,222.4	2,067.4	2,244.1
BEA 66: Pittsburgh, PA	969.2	981.8	1,041.3	1,089.7	1,118.0	1,055.6	940.8	1,074.2
BEA 115: Paducah, KY	134.2	130.6	142.6	149.7	151.9	319.2	281.9	144.9

a. Wood and paper products include lumber products, pulpwood logs and paper products.
b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.
Source: Tables 7,8, and 9.

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Table 7. Ohio River Basin: Consumption of Lumber Products, BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	2,752.3	2,651.8	2,920.2	3,068.2	3,101.7	2,692.1	2,476.8	2,960.5
BEA 47: Huntsville, AL	367.0	353.6	389.4	409.1	413.6	359.0	330.3	394.8
BEA 48: Chattanooga, TN	604.3	582.3	641.2	673.7	681.0	591.1	543.8	650.1
BEA 50: Knoxville, TN	153.1	147.5	162.5	170.7	172.6	149.8	137.8	164.7
BEA 54: Louisville, KY	535.4	515.9	568.1	596.9	603.4	523.7	481.8	575.9
BEA 62: Cincinnati, OH	644.6	621.0	683.9	718.5	726.4	630.5	580.1	693.3
BEA 66: Pittsburgh, PA	332.0	319.9	352.2	370.1	374.1	324.7	298.7	357.1
BEA 115: Paducah, KY	115.9	111.6	122.9	129.2	130.6	113.3	104.3	124.6

Note: 1970 consumption estimates for Tennessee Valley counties (BEAs 47-50) were derived from TVA estimates of production, and analyses showing that the Valley's production approximated 75 percent of its total consumption. For counties in other BEAs, consumption was estimated to be 1.33 times production which was estimated on the basis of output/employment ratios of BEAs and BEA segments in the Tennessee Valley. Estimates for other years were based on the growth rates of "apparent consumption" of lumber in the U.S. provided by the U.S. Department of Agriculture.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Tennessee Valley Authority, A Decade of Progress, 1972, and unpublished tables; U.S. Department of Agriculture, Forest Service, The Demand and Price Situation for Forest Products, 1976, pp. 40, 41, and Table 13.

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Table 8. Ohio River Basin: Consumption of Pulpwood Logs, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	6,387.3	6,627.6	7,022.8	7,660.9	7,570.4	8,492.4	8,480.8	8,205.5
BEA 47: Huntsville, AL	2,441.6	2,533.4	2,684.5	2,928.4	2,893.7	3,246.2	3,241.7	3,136.6
BEA 48: Chattanooga, TN	1,572.3	1,631.4	1,728.7	1,885.8	1,863.5	2,090.5	2,087.6	2,019.8
BEA 50: Knoxville, TN	1,678.4	1,741.5	1,845.3	2,013.0	1,989.2	2,231.4	2,228.4	2,156.1
BEA 54: Louisville, KY	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	630.8	654.7	693.7	756.7	747.9	838.9	837.8	810.5
BEA 66: Pittsburgh, PA	64.2	66.6	70.6	77.0	76.1	85.4	85.3	82.5
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: Total Tennessee Valley consumption was estimated by the Tennessee Valley Authority. Allocations to counties in the Valley (BEAs 47-50) were made on the basis of the distribution of estimated paper products production in the Valley. Estimates for other BEAs and BEA segments were computed on the basis of the ratio of pulpwood log consumption to paper products production in the Tennessee Valley.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Tennessee Valley Authority, "Annual Pulpwood Receipts by Pulpmills in the Tennessee Valley Counties," November 17, 1978, U.S. Department of Agriculture, Forest Service, The Demand and Price Situation for Forest Products, 1976-77, and Table 15.

D-3. Paper Products

The consumption of paper products in the PSAs, as well as in other areas in the United States, tends to be concentrated in metropolitan areas. These areas have large populations with large, skilled labor forces providing the necessary conditions for developing paper consuming industries such as paper box manufacturing, printing and publishing. In 1976, BEA 62 (Cincinnati) consumed the largest amount of paper products (740 thousand tons); BEAs 47 (Huntsville) and 115 (Paducah), which have low populations and less significant printing and publishing industries, consumed only 74 thousand and 20 thousand tons of paper products, respectively (Table 9).

E. Forecasting Procedures and Assumptions

Projections of the consumption of wood and paper products have been based on various existing projections. The primary sources used in this study are projections provided by the U.S. Department of Agriculture (USDA) and the U.S. Commerce Department Series E population projections (OBERS). Generally, USDA national projections of product consumption were disaggregated to BEA and BEA segments by the use of allocation factors derived from OBERS. The projected growth rates for the consumption of particular wood and paper products in each BEA segment were assumed to be the same as those of the BEA as a whole. However, procedures and assumptions used in projecting national or regional consumption vary among products. These procedures and assumptions are summarized in Table 10 and are further discussed below.

E-1. Lumber

USDA has projected U.S. consumption of lumber and other timber products to 2020.[1] The projections give explicit consideration to the growth of population, income, prices of lumber products, manufacturing, family size and the annual demand for housing in the United States by types of housing. They provide three growth rates in the population and GNP under an assumption that a long-run equilibrium will be approached. These assumptions are consistent with those used for OBERS projections, Series E population. The

1. U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resource - An Assessment, 1975 ed. (Washington, D.C.: GPO, 1977).

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Table 9. Ohio River Basin: Consumption of Paper Products, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,879.4	1,952.6	2,028.7	2,107.8	2,188.5	3,180.5	2,743.4	2,081.6
BEA 47: Huntsville, AL	66.8	69.4	72.1	74.9	77.8	75.2	64.9	74.0
BEA 48: Chattanooga, TN	106.4	110.5	114.8	119.3	124.0	119.9	103.4	117.8
BEA 50: Knoxville, TN	86.6	90.0	93.5	97.1	100.9	975.3	841.3	95.9
BEA 54: Louisville, KY	360.0	374.0	388.6	403.8	417.7	405.7	349.9	398.7
BEA 62: Cincinnati, OH	668.3	694.4	721.5	749.6	779.0	753.0	649.5	740.3
BEA 66: Pittsburgh, PA	573.0	595.3	618.5	642.6	667.8	645.5	556.8	634.6
BEA 115: Paducah, KY	18.3	19.0	19.7	20.5	21.3	205.9	177.6	20.3

Note: Consumption estimates for individual BEAs and BEA segments were based on estimates of U.S. consumption of paper products provided by the U.S. Department of Commerce. Allocations of U.S. consumption were made to Ohio River Basin counties on the basis of county employment in printing and publishing industries.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Commerce, Regional Employment by Industry, 1940-70; County Business Patterns; U.S. Industrial Outlook, 1978 ed.

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Table 10. Ohio River Basin: Summary of Projection Methodology for Wood and Paper Products

Variable	Basis for projection	Allocation methodology
Lumber production	Projection of roundwood production by state provided by U.S. Water Resources Council, 1972 OBERS Projections, Volume 1, pp. 106-107	Growth rate of roundwood production computed for each state. Rates applied to lumber production in BEAs and BEA segments within each state
Lumber consumption	U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources--An Assessment, 1975, Table 60, p. 147, medium projection	U.S. lumber consumption allocated on basis of earnings in lumber products and furniture industries in BEAs and BEA segments
Pulpwood log production	U.S. Water Resources Council, 1972 OBERS Projections, Volume 1, pp. 106-107, projection of pulpwood production, by state	Growth rates of pulpwood production computed for each state. Rates applied to lumber production in BEAs and BEA segments within each state
Pulpwood log consumption	U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources--An Assessment, 1975, Table 63, p. 156.	U.S. pulpwood consumption allocated on basis of earnings in paper products industry in BEAs and BEA segments
Paper product production	U.S. Department of Commerce, Construction and Forest Division, Model II, unpublished data (1980 projection); projections for later years are made by RRNA	U.S. paper production allocated on basis of earnings in paper products industry in BEAs and BEA segments
Paper product consumption	U.S. Department of Commerce, Construction and Forest Division, Model II, unpublished data (1980 projection); projections for later years are made by RRNA	U.S. paper product consumption allocated on basis of earnings in printing and publishing industries in BEAs and BEA segments

USDA projections described above are judged to be the most accurate projections available. Therefore, they have been used as the basis for projecting ORB consumption of lumber.

E-2. Pulpwood Logs

Sources, procedures and assumptions underlying the projections of pulpwood log consumption in the PSAs are similar to those underlying the projections of lumber consumption.

E-3. Paper Products

There are no available existing long-term national or regional projections on which to base projections of paper product consumption in the PSAs. Even short-term projections by the U.S. Department of Commerce (to 1985) are currently being revised. Since the American Paper Institute only projected the production of various paper products to 1981, no consumption projection was available. It was necessary, therefore, to develop independent projections of paper product consumption.

Based on the assumption that the consumption of paper products linearly correlates with the GNP, a simple regression was run to determine this relationship. It was found that the GNP captured 97 percent of the variations in paper product consumption.[1] The regression was used to project national consumption to the year 2000. Allocation of the projected consumption to the PSAs was then based on OBERS' distribution factors.

F. Probable Future Demand

Wood and paper product consumption in relevant BEAs, and in the Tennessee Valley area in general, is expected to grow substantially during the coming decades. The housing industry is projected, by the TVA, to be the largest wood-using industry by the turn of the century. An anticipated boom in the construction of mobile homes is a primary factor. Although the growing trend in the use of metals and other materials to replace wood in the furniture industry is expected to continue, the rapid growth of the furniture industry in the PSAs will, nevertheless, contribute to

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1. The regression equation is $C = 1353 + 70.33\ GNP$, $R^2 = 0.974$. Where C is the consumption of total paper and paperboard, measured in thousands of short tons and GNP measured in billions of constant 1958 dollars. The data covers the 1955-75 period.

the increase in lumber consumption. It is estimated that there will be as much as a 30 percent increase in the number of furniture plants operating in the southern area served by the ORS by the year 2000. Although Ohio, Indiana and Pennsylvania probably will not experience such a rapid increase, increases in these states are nevertheless expected.

During the past ten years, paper products production has expanded rapidly in the PSAs. This is expected to continue, causing a rapid increase in the consumption of pulpwood logs.

Paper product consumption in the PSAs is also expected to increase at a rapid pace, due both to increases in population and to an increase in the output of paper-using industries. The distribution of the projected consumption of wood and paper products by BEAs and BEA segments is presented in Table 11.

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Table 11. Ohio River Basin: Consumption of Wood and Paper Products, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated	Projected					Average annual percentage and change	
	1976[b]	1980[c]	1990[c]	2000[c]	2020[c]	2040[d]	1976-1990	1976-2040
Primary Study Areas	13,247.5	15,811.4	22,971.2	29,984.7	45,873.4	58,779.1	4.01	2.36
BEA 47: Huntsville, AL	3,605.3	4,778.1	7,566.2	10,342.6	15,289.2	19,085.4	5.44	2.64
BEA 48: Chattanooga, TN	2,787.7	3,045.0	3,859.0	4,681.7	6,595.2	8,027.0	2.35	1.67
BEA 50: Knoxville, TN	2,416.7	2,959.8	5,063.2	7,171.9	12,143.8	16,395.4	5.42	3.04
BEA 54: Louisville, KY	974.6	1,106.8	1,400.7	1,667.0	2,549.1	3,337.2	2.62	1.94
BEA 62: Cincinnati, OH	2,244.1	2,507.9	3,204.2	3,822.8	5,655.6	7,118.4	2.58	1.82
BEA 66: Pittsburgh, PA	1,074.2	1,247.2	1,680.8	2,076.6	3,348.0	4,454.9	3.25	2.25
BEA 115: Paducah, KY	144.9	166.9	197.1	222.1	292.5	360.8	2.22	1.44

a. BEA segments defined as counties which are ultimate origins or destinations or waterborne movements.
b. Estimated 1976 consumption from Table 6. Wood and paper products include pulpwood logs, lumber products and paper products.
c. Consumption of lumber products based on OBERS growth rates of earnings in lumber product and furniture industries, by BEA, adjusted by the U.S. ratio of earnings to consumption in the industries. Consumption of pulpwood log and paper products are projected by the same method, using the growth rates of earnings in the paper products industry and earnings in the printing and publishing industries, respectively.
d. Rates of growth in the consumption of wood and paper products commodities for 2020-2040 are assumed to equal one-half of growth rates between 2000-2020.
Source: U.S. Water Resources Council, 1972 OBERS Projections, Volumes 1 and 2; U.S. Department of Commerce, Bureau of Domestic Commerce, data on file; U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources--An Assessment, 1975 ed.

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III. COMMODITY RESOURCES INVENTORY

Production of wood and paper products in the PSAs increased from 4.8 million tons to 5.8 million tons during the period 1969-76, an average increase of 2.6 percent per year. Through the year 2000, production in the PSAs is projected to increase at a higher annual rate of 2.87 percent. During the period 2000-2040, however, the increase in production is projected to be slower. It is expected that the annual average increase will be only 1.51 percent per year.

A. Production Areas

The production of Group X commodities in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group X waterborne movements destined to the Ohio River Basin.

In 1969, New Orleans (BEA 138) shipped some 60 thousand tons of imported paper products to the ORB. By 1976, however, the ORB was almost self-sufficient in paper products production and the significance of SPAs had drastically declined (Table 3).

B. Production Characteristics and Industry Feedstock

The production characteristics of wood and paper products are determined by factors affecting the production of individual products. These include land availability and ownership, product prices, and existing technology.

B-1. Lumber

Roundwood is usually transported short distances to sawmills for lumber processing. The production of lumber in a PSA, therefore, depends largely on its forest resources and the location of mills. Future production will be strongly influenced by the availability of forest land and forest management programs.

Today, more than 700 million acres are classified as forest land in the United States. Two-thirds of the nation's forest land is capable of producing 200 cubic feet per acre or more of lumber per year and is classed as commercial timberland.[1] Nearly three-quarters of the U.S. commercial timberland is located in the central and eastern parts of the United States. Conversion of abandoned agricultural land into forest land caused an increase in commercial timberland acreage in the years following World War II. However, since 1960, urbanization and population growth have reversed this trend. In 1962, there were 511 million acres of commercial timberland in the United States; the amount of timberland had decreased to 500 million acres in 1970, and to 488 million acres in 1977.

Kentucky and Tennessee account for nearly all forest areas in the study areas. In 1977, these two states accounted for 25 million acres, or about 5 percent, of the total U.S. commercial timberland acreage. Approximately 22.5 million acres were privately owned.[2] The large number of small, and relatively small, private forest land owners has caused considerable difficulty in promoting efficient forest management programs. Also, the increasing population and the expansion of metropolitan areas, together with restrictive land use laws arising from environmental concerns, are factors restricting the growth of forest industries in the PSAs.

Despite these constraints, forest industry and lumber production can experience rapid growth if the market price of lumber increases sufficiently. High prices would encourage technologies which can make more intensive use of wood. Labor productivity would be thereby increased and better forest management would be stimulated.

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1. U.S. Department of Agriculture, Forest Service, The Nation's Renewable Resources - An Assessment, 1975 ed. (Washington, D.C.: GPO, 1977), p. 12.
2. U.S. Department of Agriculture, Forest Statistics of the U.S. 1977 ed. (Washington, D.C.: GPO, 1978), Table 2.

B-2. Pulpwood Logs

The factors which will influence the production of pulpwood logs in the PSAs are much the same as those which will influence lumber production (i.e., market prices, technology and forest management).

B-3. Paper Products

The paper products industry is strongly governed by new technologies which allow economical uses of low cost raw materials. In the 1959-70 period, production of paper products required an increasing proportion of woodpulp and a decreasing proportion of waste paper. Shortages and high prices of pulpwood, together with environmental concerns, have reversed this trend and resulted in the use of more waste paper and wood residues from lumber and plywood mills. Accordingly, the industry can be expected to be less dependent on the production of pulpwood logs in the future than it was in the past.

C. Existing Production Levels

The production of wood and paper products, as a group, increased in the ORB at an average rate of 2.6 percent per year in the 1969-76 period. In 1976, total PSA production stood at 5.8 million tons. Lumber, pulpwood logs and paper products contributed almost equal tonnages to this total. BEAs 47 (Huntsville) and 48 (Chattanooga), the largest producing PSAs, accounted for 69 percent of the total wood and paper product production in the PSAs (Table 12).

C-1. Lumber

Total production of lumber in the PSAs increased steadily from 1969 to 1976 (Table 13). Even in the 1972-76 period, production increased in the PSAs (primarily in Tennessee Valley sawmills) while the rest of the nation was experiencing a decline due to recession. This is an indication of the potential strength and stability of the lumber industry in the area served by the ORS.

Unlike the hardwood lumber production which predominates in the Appalachian region and the Tennessee Valley as a whole, most PSAs produce approximately equal shares of hardwood and softwood lumber. Hardwood lumber includes white and red oak, yellow poplar,

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Table 12. Ohio River Basin: Production of Wood and Paper Products,[a] by BEA or BEA Segments,[b] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	4,833.1	4,945.2	5,048.2	5,340.0	5,469.2	5,842.0	5,490.7	5,788.4
BEA 47: Huntsville, AL	1,864.0	1,900.1	1,931.5	2,048.0	2,101.9	2,161.0	2,068.0	2,196.4
BEA 48: Chattanooga, TN	1,547.8	1,578.5	1,595.7	1,682.5	1,732.4	1,856.9	1,679.0	1,822.1
BEA 50: Knoxville, TN	620.0	644.8	675.5	731.6	740.8	844.2	798.1	814.7
BEA 54: Louisville, KY	333.2	337.8	342.5	347.4	352.3	414.3	362.4	367.5
BEA 62: Cincinnati, OH	162.1	168.3	178.3	194.5	192.2	215.6	215.3	208.3
BEA 66: Pittsburgh, PA	199.4	202.6	206.2	210.5	213.0	250.2	221.9	223.0
BEA 115: Paducah, KY	106.6	113.1	118.5	125.5	136.6	99.8	146.0	156.4

a. Wood and paper products include lumber products, pulpwood logs and paper products.
b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.
Source: Tables 13, 14, and 15.

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Table 13. Ohio River Basin: Production of Lumber Products, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,480.8	1,492.8	1,505.8	1,519.7	1,534.6	1,564.1	1,570.0	1,587.2
BEA 47: Huntsville, AL	457.6	455.7	453.9	452.1	450.3	366.5	447.2	445.4
BEA 48: Chattanooga, TN	380.5	377.5	374.4	371.4	368.5	389.5	363.0	360.1
BEA 50: Knoxville, TN	47.9	52.1	56.8	61.8	67.3	101.4	79.9	87.0
BEA 54: Louisville, KY	324.2	328.7	333.3	338.0	342.7	404.6	352.6	357.5
BEA 62: Cincinnati, OH	--	--	--	--	--	--	--	--
BEA 66: Pittsburgh, PA	182.9	185.5	188.1	190.7	193.4	228.3	200.0	201.8
BEA 115: Paducah, KY	87.7	93.3	99.3	105.7	112.4	73.8	127.3	135.4

Note: For BEAs 47-50, 1970 estimates were provided by the Tennessee Valley Authority, County Forest Industry Facts, Tennessee Valley, 1970, Table 3, adding 8 percent to adjust for inclusion of noncommercial sawmills cutting less than 400,000 board feet; 1974 and 1975 estimates are based on other TVA publications, adding 10.3 percent to the 1975 estimates which excluded noncommercial sawmills. Aggregated estimates were disaggregated, when necessary, based on forest acreage estimates provided by the U.S. Department of Agriculture. Lumber products production estimates for the remaining BEAs were estimated on the basis of the ratio of production to employment in lumber products industries in BEA segment 49, and employment data for the counties in the BEA segments. County employment in lumber products industries was determined from the U.S. Census of Manufactures using the ratio of lumber employment to lumber and wood products employment in each county. Estimates for other years were extrapolated from the 1970-75 trend.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Tennessee Valley Authority, County Forest Industry Facts, Tennessee Valley, 1970, Table 3; Lumber for Industry, 1974 and 1975, A Summary of Lumber Production in the 125 Tennessee Valley Counties, 1977; U.S. Department of Agriculture, Forest Service, Forest Area Statistics for Mid-South Counties, 1973; U.S. Department of Commerce, Bureau of the Census, Census of Manufactures, 1972 ed.

and hickory. Softwood species include yellow and white pine. A notable Secondary Production Area in earlier years was BEA 138 (Baton Rouge), an origin of imported lumber. Since 1974, however, shipments of imported lumber to the ORS via the waterway have declined to negligible levels.

C-2. Pulpwood Logs

Following the distribution of roundwood and lumber production, the production of pulpwood logs is concentrated in BEAs 47 (Huntsville) and 48 (Chattanooga) (Table 14). About 1.9 million tons were produced in these PSAs, accounting for nearly 90 percent of production in the PSAs.

There are no Secondary Production Areas in which pulpwood logs are consumed in the Ohio River Basin.

C-3. Paper Products

Since paper production often consumes a substantial amount of water, paper products are produced in the PSAs by pulp and paper mills located within the proximity of the waterways. The waterway also provides an economical means to transport required raw materials.

Pulp and paper production is a relatively young industry in Kentucky. The first pulp and paper mill in the state began operations in 1967 in Hanesville. Two years later, second and third mills went into production. In contrast, the Tennessee Valley has been a large and growing paper producing area, particularly BEAs 47 (Huntsville), 48 (Chattanooga), and 50 (Knoxville) (Table 15). Map 1 indicates the locations of pulp and paper mills in the PSAs.

D. Forecasting Procedures and Assumptions

The methodology for projecting lumber and pulpwood production in the PSAs is presented in Table 10. In general, the PSA projections have been based on existing projections developed by the U.S. Department of Commerce.

D-1. Lumber

The OBERS projections, prepared by the U.S. Department of Commerce for the U.S. Water Resources Council, served as a basis for estimating the growth of state lumber production. Growth rates

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Table 14. Ohio River Basin: Production of Pulpwood Logs, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,710.8	1,748.7	1,737.2	1,851.2	1,988.5	2,095.0	1,740.6	2,092.2
BEA 47: Huntsville, AL	779.0	793.2	787.6	843.3	907.8	960.1	787.5	944.9
BEA 48: Chattanooga, TN	763.2	781.6	776.9	826.3	884.8	930.0	779.3	942.8
BEA 50: Knoxville, TN	140.7	145.0	144.3	152.4	162.1	169.2	145.3	173.5
BEA 54: Louisville, KY	9.0	9.1	9.2	9.4	9.6	9.7	9.8	10.0
BEA 62: Cincinnati, OH	--	--	--	--	--	--	--	--
BEA 66: Pittsburgh, PA	--	--	--	--	--	--	--	--
BEA 115: Paducah, KY	18.9	19.8	19.2	19.8	24.2	26.0	18.7	21.0

Note: Pulpwood log production for BEA segments 47-50 and 115 estimated from county data provided by the Tennessee Valley Authority for 1976. Estimates for 1969-75 for these segments were based on the 1976 data, and the growth trend of pulpwood production by U.S. Production Regions defined by the U.S. Department of Agriculture. Production in other BEA segments based on conversations with and data provided by the Kentucky Division of Forestry.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Tennessee Valley Authority, "1976 Pulpwood Production for the Tennessee Valley" (computer print-out); U.S. Department of Agriculture, Southern Pulpwood Production, 1976, and The Demand and Price Situation for Forest Products, 1976-77, Table 31, p. 80.

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Table 15. Ohio River Basin: Production of Paper Products, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	1,641.5	1,703.7	1,805.2	1,969.1	1,946.1	2,182.9	2,180.1	2,109.0
BEA 47: Huntsville, AL	627.4	651.2	690.0	752.6	743.8	834.4	833.3	806.1
BEA 48: Chattanooga, TN	404.1	419.4	444.4	484.8	479.1	537.4	536.7	519.2
BEA 50: Knoxville, TN	431.4	447.7	474.4	517.4	511.4	573.6	572.9	554.2
BEA 54: Louisville, KY	--	--	--	--	--	--	--	--
BEA 62: Cincinnati, OH	162.1	168.3	178.3	194.5	192.2	215.6	215.3	208.3
BEA 66: Pittsburgh, PA	16.5	17.1	18.1	19.8	19.6	21.9	21.9	21.2
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: 1976 estimates based on published data. Estimates for 1969-75 based on the trend in pulpwood receipts by pulpmills in the Tennessee Valley counties during the period.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Tennessee Valley Authority, "Annual Pulpwood Receipts by Pulpmills in the Tennessee Valley Counties," November 7, 1978; and Lockwood Directory of the Paper and Allied Trade.

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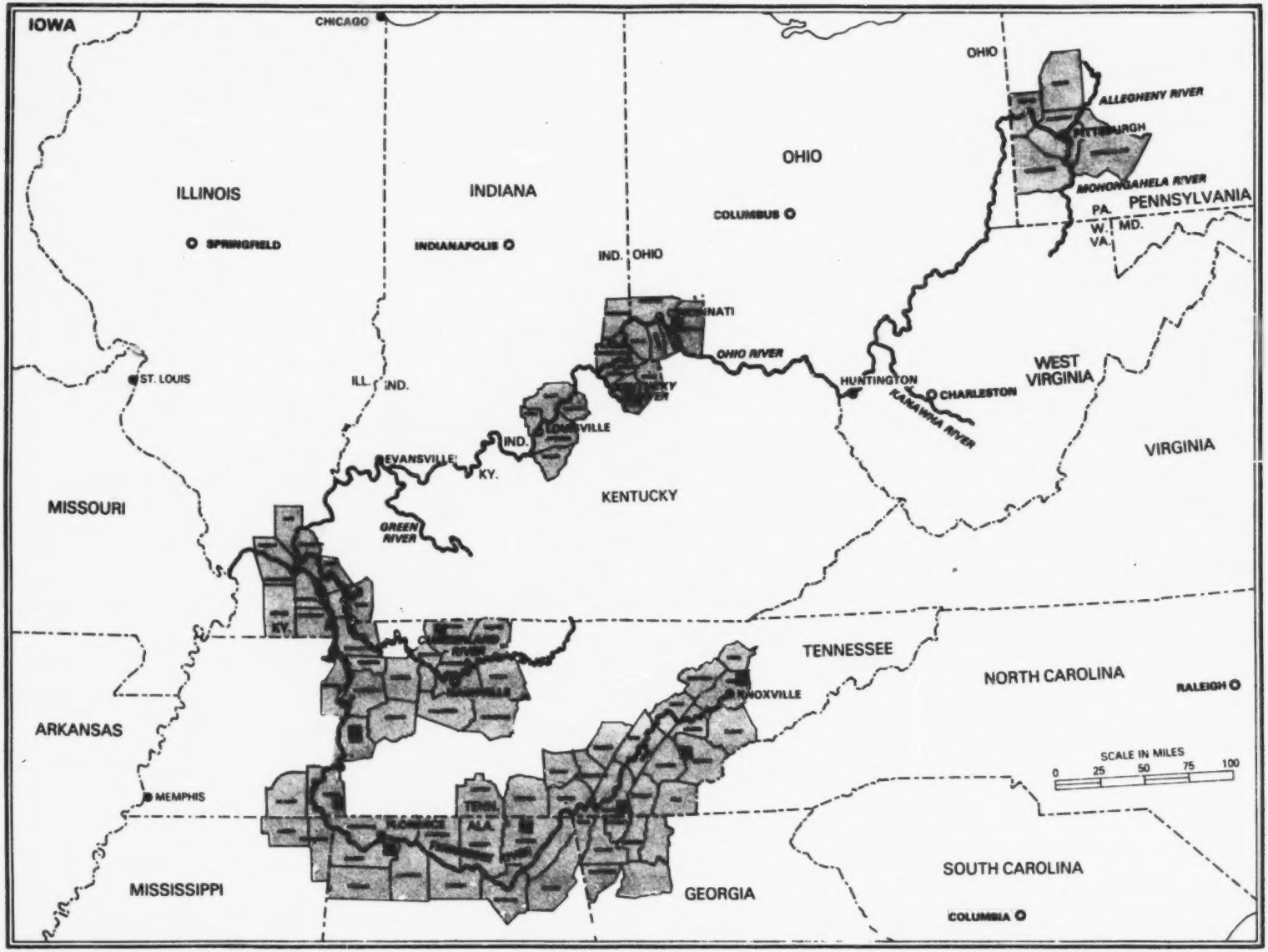
MAP 1. PRIMARY STUDY AREAS FOR WOOD AND PAPER PRODUCTS
LOCATION OF PULP MILLS, 1976



■ Pulp Mill Locations
Primary Study Areas

SOURCE Prepared by RRNA from the Lockwood Directory of the Paper and Allied Trade. Vance Pub lishing Company 1976

for lumber production were assumed to be the same as those for roundwood production at state levels, with an additional assumption that portions of PSAs within each state would match the state's growth rate.

D-2. Pulpwood Logs

OBERS projections of pulpwood production, by state, were available to 2020. The assumption that the growth rate of pulpwood production in BEAs and BEA segments within a state would equal the growth rate of pulpwood logs production by the state as a whole was adopted. Production was assumed to increase in the period 2020-2040 at a rate equal to half the increase projected for the period 2000-2020.

D-3. Paper Products

U.S. production of paper products has been projected by the Stanford Research Institute (SRI) for the U.S. Department of Commerce. The SRI projection for 1980 was adopted. Assuming that the ratio between earnings in the paper industries and paper production would be the same for the United States and the PSAs, projections of PSA production of paper products were derived from the national projections. Projections for 1990 and later years were made assuming that paper production would grow at the same rate as the pulpwood consumption in the PSAs. These projections are conservative in the sense that they do not take into account the possibility of new technologies which may decrease the proportion of pulpwoods in the production of paper products; hence, a more rapid growth of paper products production.

E. Probable Future Production Levels

The production of total wood and paper production in the PSAs in the year 2000 is expected to double the production of 1976. Production will continue to increase between 2000 and 2040 but at a reduced rate. BEAs 47 (Huntsville) and 48 (Chattanooga) have accounted, and will continue to account, for a major share of total production in the PSAs (Table 16).

E-1. Lumber

The national production of hardwood sawtimber is expected to increase nearly 8 billion board feet between 1970 to 2000. While Kentucky is not expected to contribute substantially to this growth, lumber production in BEAs 54 (Louisville) and 115

Table 16. Ohio River Basin: Production of Wood and Paper Products, by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated	Projected					Average annual percentage change	
	1976[b]	1980[c]	1990[c]	2000[c]	2020[d]	2040[d]	1976-1990	1976-2040
Primary Study Areas	5,788.2	6,922.7	9,049.7	11,407.6	16,796.1	20,808.0	3.24	2.02
BEA 47: Huntsville, AL	2,196.3	2,727.9	3,617.6	4,586.3	6,849.3	8,534.1	3.63	2.14
BEA 48: Chattanooga, TN	1,822.1	2,097.7	2,648.8	3,272.4	4,760.2	5,844.9	2.71	1.84
BEA 50: Knoxville, TN	814.6	1,012.4	1,435.1	1,899.7	2,999.5	3,877.8	4.13	2.47
BEA 54: Louisville, KY	367.5	416.5	507.6	608.9	759.3	855.0	2.33	1.33
BEA 62: Cincinnati, OH	208.3	222.3	268.1	324.1	454.3	545.6	1.82	1.52
BEA 66: Pittsburgh, PA	223.0	260.7	335.6	420.0	564.6	661.9	2.96	1.71
BEA 115: Paducah, KY	156.4	185.2	236.9	296.2	408.9	488.7	3.01	1.80

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.
b. Estimated 1976 production from Table 12. Wood and paper products include pulpwood logs, lumber products and paper products.
c. Production of lumber products projected assuming the same growth rates as those of roundwood production. BEA roundwood production growth for 1976-80, 1980-90, 1990-2000-2020, computed by applying state growth rates to BEAs within each state. Pulpwood production projected using the same method, but applying the state growth rates for pulpwood production. Paper production growth rates based on OBERS projections of earnings in the paper products industry, by BEA, and the U.S. ratios of paper products earnings to production in the paper products industry. BEA segments production growth in the 2020-2040 period assumed one-half the growth rates of the 2000-2020 period.
Source: U.S. Water Resource Council, 1972 OBERS Projections, Volumes 1 and 2; U.S. Department of Commerce, Bureau of Domestic Commerce, data on file, and RRNA estimates.

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(Paducah), which include some counties located in Kentucky, is expected to experience moderate growth due to the increasing concentration of the industry in these BEAs. Softwood lumber production in these BEAs is not expected to grow significantly.

Tennessee Valley PSAs, on the other hand, are expected to experience relatively rapid growth of both hardwood and softwood lumber. The TVA estimates that forests have been growing at a rate 3.8 times faster than they are being cut in recent years. By 2000, with good forest management, the Valley counties will be capable of producing wood at a rate approximately three to four times the 1970 level. However, past difficulties in forest management and land ownership are likely to continue; consequently, the lumber production in Tennessee Valley PSAs is expected to, on the average, only to double the 1976 level by 2000. It will, then, increase at a relatively slower rate between 2000 and 2040.

E-2. Pulpwood Logs

Pulpwood log production in the PSAs, amounting to 2.4 million tons in 1976, is expected to reach 4.7 million tons in 2000 and 8.4 million tons in 2040. BEAs 47 (Huntsville) and 48 (Chattanooga) will continue to be the major production areas in the future, accounting for nearly 80 percent of production in the PSAs. The overall production characteristics of pulpwood logs are similar to those of lumber, as discussed above.

E-3. Paper Products

From the standpoint of product value, the TVA expects that the Tennessee Valley pulpwood paper industry will be the second largest forest based industry, after home construction, by the year 2000. Paper production in PSAs outside the Tennessee Valley, although not as important, will also increase at a rapid rate. Paper product production in the PSAs is projected to increase from 2.6 million tons in 1976 to 5.8 million tons in 2000 and to 11.4 million tons in 2040. Production will be most significant in BEAs 47 (Huntsville) and 50 (Knoxville).

The growth in production is expected to take place as the result of improved production techniques and plant expansion. For example, Bowater Inc., in Calhoun, Tennessee, has announced a capacity expansion of 140 thousands tons in newsprint production in 1979. Champion International Corp., in Courtland, Alabama, will increase its production capacity for uncoated free sheet by 150 thousand tons in 1980. It is expected that there will be very few,

if any, new plants in the PSAs. The TVA has assessed the potential for new plants and has identified seven possible pulpmill sites in the PSAs. However, the chances for the construction of plants at these sites are slight.

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IV. TRANSPORTATION CHARACTERISTICS

In the United States, wood and paper products are generally transported by rail and truck. Waterway movements are not common. While this pattern of transport also applies in the area served by the ORS, the convenience of the rivers flowing through producing and consuming areas provides some exceptions.

A. Existing and Historical Modal Split

The large and expanding lumber and wood products industries of the PSAs chiefly use truck transport for both finished products and raw materials. Contrary to common beliefs based on the practice of several decades ago, rafted logs are no longer transported via the waterways. Water movements of lumber products are limited, and pulp and paper mills, especially larger ones, receive about two-thirds of their raw materials by rail. Only one pulpmill in the PSAs, located in BEA 48 (Chattanooga), received pulpwood logs by barge. However, waterborne shipments account for less than 20 percent of the mill's annual requirements.

Years ago large quantities of newsprint (i.e. 107 thousand tons in 1969) were transported from BEA 48 to Houston, Cincinnati and BEAs along the upper Mississippi River. However, in recent years, truck and rail have almost completely replaced barge as a carrier of paper products on the Mississippi. This change has occurred partly as a result of shifts in markets and partly as a result of the ability of other modes to deliver the products to consumers directly and quickly. Today, the movement of paper products by water is limited to a small section on the Tennessee River in which barges transport paper from waterside mills to a railroad terminal. The modal split for wood and paper product movements in the area served by the ORS in 1976 is presented in Table 17.

B. Factors Affecting Modal Choice

The relative shares of net movements of rail, water and truck are presented in the last three columns of Table 17.

Table 17. Ohio River Basin: Production and Consumption of Wood and Paper Products[a], by Product, and Net Shipments by Mode of Transportation and by BEA or BEA Segments [b], Estimated 1976

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Production				Consumption				Net shipments (receipts)				
									Total		Mode of Transport		
	Total	Lumber	Pulpwood logs	Paper products	Total	Lumber	Pulpwood logs	Products	Amount	As a percent of consumption	Water	Rail	Truck
Primary Study Areas	5,788.3	1,587.2	2,092.1	2,109.0	13,247.5	2,960.4	8,205.5	2,081.6	(7,459.2)	56.3	31.1	(1,966.9)	(5,523.4)
BEA 47: Huntsville, AL	2,196.3	445.4	944.8	806.1	3,605.3	394.7	3,136.6	74.0	(1,409.0)	39.1	214.8	25.3	(1,649.1)
BEA 48: Chattanooga, TN	1,822.1	360.1	942.8	519.2	2,787.7	650.1	2,019.8	117.8	(965.6)	34.6	(249.3)	(827.4)	111.1
BEA 50: Knoxville, TN	814.7	87.0	173.5	554.2	2,416.7	164.7	2,156.1	95.9	(1,602.0)	66.3	43.4	59.4	(1,704.8)
BEA 54: Louisville, KY	367.5	357.5	10.0	--	974.6	575.9	--	398.7	(607.1)	62.3	2.2	(219.9)	(369.4)
BEA 62: Cincinnati, OH	208.3	--	--	208.3	2,244.1	693.3	810.5	740.3	(2,035.8)	90.7	23.3	(388.2)	(1,670.9)
BEA 66: Pittsburgh, PA	223.0	201.8	--	21.2	1,074.2	357.1	82.5	634.6	(851.2)	79.2	(7.8)	(599.9)	(243.5)
BEA 115: Paducah, KY	156.4	125.4	21.0	--	144.9	124.6	--	20.3	11.5	--	4.5	3.8	3.2

Note: Gross and net waterborne and rail shipments (receipts) were determined for 1976 from U.S. Corps of Engineers waterborne commerce data and Interstate Commerce Commission railroad waybil data. Total net shipments (receipts) were determined by subtracting production from consumption. Net truck shipments (receipts) were determined by subtracting net waterborne and rail shipments (receipts) from total net shipments (receipts).

a. Including only commodities generating significant Ohio River System traffic.

b. BEA segments defined as counties which are ultimate origins and destinations of waterborne movements.

Sources: Estimated production and consumption from Tables 7, 8, 9, 13, 14, and 15. Water and rail shipments (receipts) compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, and ICC Railroad Waybil Sample, 1976, supplied by the U.S. Army Corps of Engineers.

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As in the case of other commodities, the choice of mode for the transportation of wood and paper products is influenced by the transport rates and times which are implicit in the location of consumption and production areas. The demand for water transportation of wood and paper products is price inelastic. Discussion with industrial authorities and shippers indicates that even if barge rates increase as much as 50 percent, most barge users would not likely switch to another mode of transportation. Similarly, a change in transport time, within a technologically feasible range, is not expected to cause a significant shift in the current modal choice.

The choice of a wood and paper transport mode is largely governed by the location of the consumption market relative to the producing sources. A significant portion of wood products produced in the PSAs is sent to metropolitan areas in central Illinois, Indiana and Ohio or is shipped to the east coast both for domestic consumption and for export. In such cases, there is no convenient waterway transportation route; hence, rail has an advantage in both transport cost and time.

For the movement of wood and paper products from Knoxville to the Nashville area, truck is most often used. Barge transportation would require a journey consisting of the whole length of the Tennessee River and one half of that of the Cumberland River, a distance more than four times longer than those of truck routes.

On the other hand, barge transport has an absolute advantage over other modes when production and consumption areas are located in the proximity of the Tennessee River which provides a relatively direct route between the two areas. This is certainly true in the case of pulpwood logs and paper products. Discussions above indicate that most paper production activities are concentrated along the Tennessee River. These paper and pulpmills use pulpwood logs which are produced in large quantities in BEAs 47 (Huntsville) and 48 (Chattanooga). Thus, the Tennessee River provides the most direct and cheapest transportation route between the producers and consumers of pulpwood logs. Pulpwood log transportation accounts for an extensive use of this waterway. In fact, the movements of pulpwood logs and paper products in this area accounted for 86 percent of the total ORS waterborne transportation of wood and paper products in 1976. As long as production of pulpwood logs does not relocate, barge transportation of pulpwood logs in this area is expected to remain very significant in the future.

C. Forecasting Procedures and Assumptions

Forecasts of future shipments and receipts of wood and paper products are based primarily on projections of production and consumption of these commodities. Initial projections of waterborne commerce were developed using preliminary information provided by the Corps of Engineers. These initial projections were based on the 1976 modal split by BEA and BEA segment. Projections of total net shipments/receipts of each of the seven BEA segments were made by comparing the projected future production and consumption of wood and paper products of these BEAs. The total net shipments/receipts were then distributed to rail, truck and water based on existing patterns. Gross water movements were assumed to maintain the same relationship to net water movements in the future as in the past.

These projections of waterborne shipments and receipts were distributed to BEA links using historical distribution of shipments data among BEA receivers. These projections were adjusted for projected changes in BEA shipments and receipts from specific knowledge acquired by commodity specialists during the course of this study.

As more complete information was made available by the Corps of Engineers, the initial projections of BEA-to-BEA waterborne traffic were adjusted.[1]

Based on the assumption that there is no change in relative prices of transport modes, and based on the conjecture that relative transport time will not change significantly, it is expected that the future modal split will not vary significantly from the 1976 splits for each BEA and BEA segment. The change in barge transportation for the PSAs as a whole, however, is captured by the different growth rates of production and consumption of each PSA (Table 18).

A notable exception is the projected opening of a major new link, from BEA 115 (Paducah) to BEA 48 (Chattanooga), by the year 1990. This new link will be created because BEA 48, whose paper industry is projected to experience a very rapid growth, will have to purchase additional new materials from other areas. BEA 115's increasing surplus of pulpwood logs, together with its convenient location on the Tennessee River, would be a likely source from which to meet this new demand.

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1. A description of the manner in which the initial projections were adjusted is contained in the Methodology Report.

D. Probable Future Waterway Traffic Flows

BEA-to-BEA waterborne traffic projections are presented in Table 19. Growth indices derived from the traffic projections are presented in Table 20.

The average annual growth rates of gross waterborne wood and paper product shipments in the ORS are projected at 1.9 percent between 1976 and 2000 and 1.2 percent during the period 2000-2040. Such rates occur because of the low growth rate of local shipments relative to other shipments. Since both inbound and outbound movements are small for the wood and paper products group, local movements are actually the better indicator of ORS waterborne movements. Local movements are projected to grow at an annual rate of 1.6 percent between 1976 and 2000 and 1.1 percent between 2000 and 2040. The total (gross) waterborne shipments will reach 1,432.3 thousand tons in 2040 as compared to 564.0 thousand tons in 1976. Waterborne wood and paper product movements are expected to continue to be relatively insignificant in the Ohio River System in the future.

Table 18. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Wood and Paper Products Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated	Projected					Average annual percentage change	
	1976	1980	1990	2000	2020	2040	1976-2000	2000-2040
Production	5,788.3	6,922.7	9,049.7	11,407.6	16,796.1	20,808.0	2.9	1.5
Consumption	13,247.5	15,811.4	22,971.2	29,984.7	45,873.4	58,779.1	3.5	1.7
Net shipments (receipts)	(7,459.2)	(8,888.7)	(13,921.5)	(18,577.1)	(29,077.3)	(37,971.1)	3.9	1.8
Net waterborne	31.1	36.6	66.5	100.4	156.4	191.1	5.0	1.6
Net rail	(1,966.9)	(2,094.0)	(2,655.5)	(3,096.5)	(4,675.1)	(6,053.3)	1.9	1.7
Net truck	(5,523.4)	(6,831.3)	(11,332.5)	(15,581.0)	(24,558.6)	(32,108.9)	4.4	1.8
Gross waterborne shipments:								
Outbound	39.9	43.8	80.3	117.2	184.4	229.2	4.6	1.7
Inbound	8.8	7.2	13.8	16.8	28.0	38.1	2.7	2.1
Local	515.3[a]	507.2	645.7	751.6	978.7	1,165.0	1.6	1.1
Total	564.0[a]	558.2	739.8	885.6	1,191.1	1,432.3	1.9	1.2

Note: Projected net shipments (receipts) determined by subtracting projected consumption from projected production. Initial projections of waterborne shipments and receipts were based on preliminary information provided by the Corps of Engineers. Projected modal split by BEA and BEA segment would remain constant in the future except when data, analyses and conversations with industrial authorities indicated otherwise. Gross waterborne shipments (inbound, outbound, local) were projected by assuming that the relationship between gross and net waterborne shipments in 1976 would remain constant in the future except when data, analyses and conversations with industrial authorities indicated otherwise. As more complete information regarding 1976 waterborne traffic was made available, BEA to BEA traffic projections were revised, and projected to increase/decrease at the same rates as projected earlier. Net truck and net rail shipments by BEA and BEA segment were assumed to have the same relationship that existed in 1976.

a. Excluding 2.7 thousand tons transshipped which is projected to be negligible beginning in 1980.

Source: Tables 11, 16, and 17; Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

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Table 19. Ohio River System: BEA-to-BEA Waterborne Traffic of Wood and Paper Products, Actual 1976 and Projected 1980-2040, Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS					
			1976	1980	1990	2000	2020	2040
047	047	10	1881	1845	2359	2744	3574	4251
047	048	10	2148	2107	2436	2625	2580	2670
047	114	10	0	0	60	110	300	260
047	144	10	0	0	170	350	500	680
048	048	10	690	598	615	562	687	1043
048	107	10	11	12	23	34	54	67
048	114	10	11	11	13	21	37	57
048	144	10	67	66	79	106	151	223
050	048	10	434	506	983	1428	2476	3391
054	138	10	22	25	32	39	65	90
062	138	10	243	273	351	418	620	784
107	138	10	27	0	0	0	0	0
115	043	10	0	0	64	157	270	295
115	066	10	0	16	0	0	0	0
115	915	10	45	51	75	94	117	131
117	066	10	11	9	17	21	36	50
135	066	10	67	51	106	130	219	299
138	062	10	10	12	15	17	25	32
		TOTAL	5667	5582	7398	8856	11911	14323

Note: BEA 915 refers to counties of BEA 115 which are destinations of waterborne movements shipped to points on the Mississippi River.

Source: Robert R. Nathan Associates, Inc.

Table 20. Ohio River System: Growth Rates of Wood and Paper Products Waterborne Commerce, BEA to BEA, Projected 1976-2040, Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
047047	10	1881	1000	981	1254	1459	1900	2260
047048	10	2148	1000	981	1134	1222	1201	1243
047114	10	60	0	0	1000	1833	5000	4333
047144	10	170	0	0	1000	2059	2941	4000
048048	10	690	1000	867	892	814	1286	1511
048114	10	11	1000	1000	1143	1952	3381	5190
048144	10	67	1000	984	1175	1587	2254	3333
050048	10	434	1000	1166	2265	3291	5706	7813
054138	10	22	1000	1150	1450	1750	2950	4100
062138	10	243	1000	1123	1443	1719	2552	3227
107138	10	27	1000	0	0	0	0	0
115915[d]	10	45	1000	1139	1667	2083	2611	2917
115048	10	64	0	0	1000	2453	4219	4609
115066	10	16	0	1000	0	0	0	0
117066	10	11	1000	786	1571	1929	3286	4500
135066	10	67	1000	754	1579	1947	3263	4456
138062	10	10	1000	1167	1500	1667	2500	3167
048107	10	11	1000	1043	2058	3073	4895	6111

a. The first three digits indicate the BEA of origin; the last three digits indicate the BEA of destination.

b. Hundreds of tons.

c. Growth rates are reported such that 1000 equals the index value reported in the third column.

d. BEA 915 refers to counties of BEA 115 which are destinations of waterborne movements shipped to points on the Mississippi River.

Source: Robert R. Nathan Associates, Inc.

V. APPENDIX

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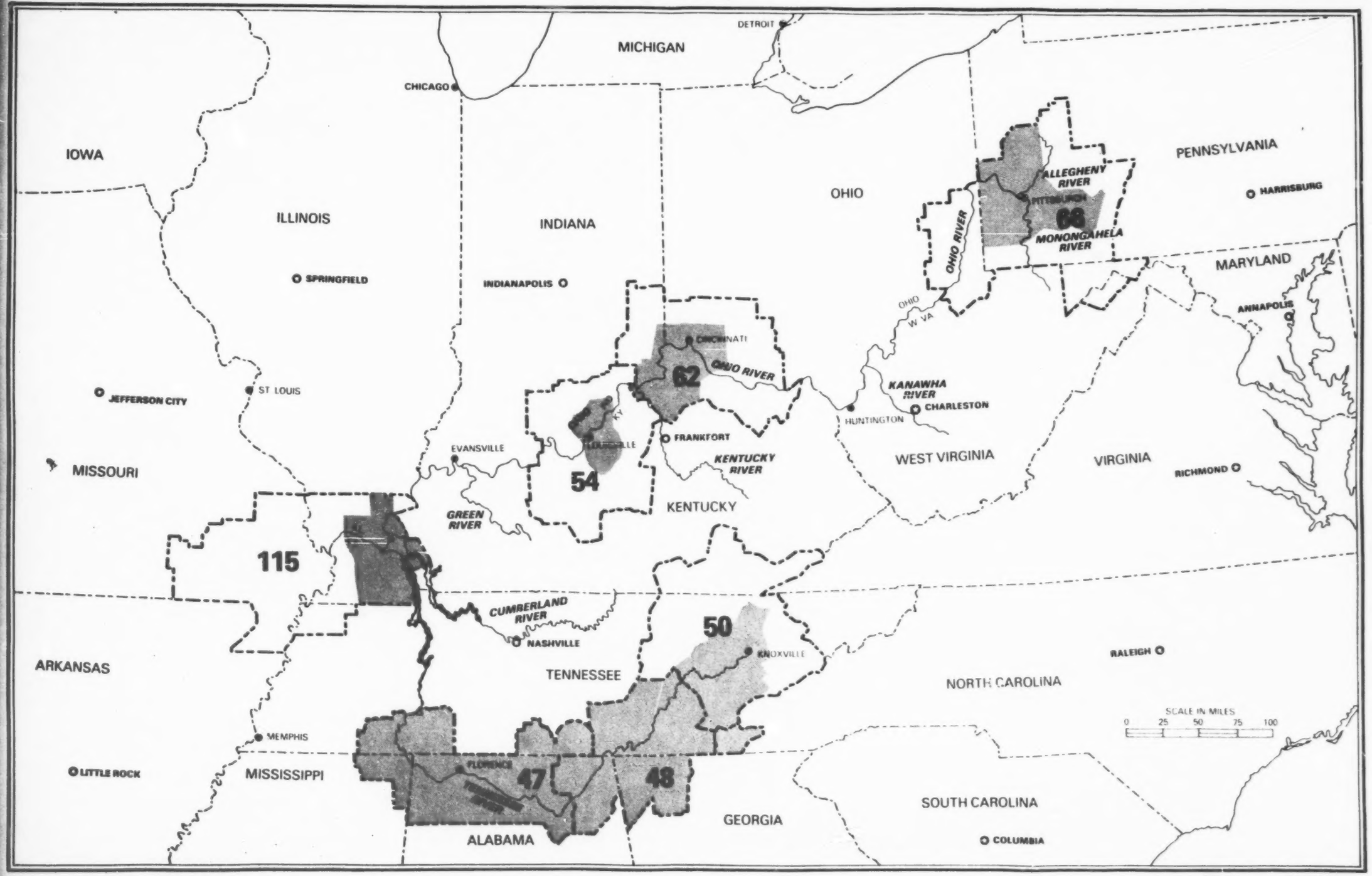
MAP A-1. PRIMARY STUDY AREAS FOR WOOD AND PAPER PRODUCTS
(BEAs AND BEA SEGMENTS)



SOURCE: Robert R. Nathan Associates, Inc.

■ Primary Study Areas

Table A-1. Ohio River Basin: Primary Study Areas for Wood and Paper Products
(BEAs and BEA Segments)

BEA 47: Huntsville, AL

- Hardin, TN
- McNairy, TN
- Wayne, TN
- Alcorn, MS
- Tishomingo, MS
- Colbert, AL
- Franklin, AL
- Lauderdale, AL
- Lawrence, AL
- Limestone, AL
- Madison, AL
- Marshall, AL
- Morgan, AL
- Franklin, TN
- Lincoln, TN

BEA 48: Chattanooga, TN

- Jackson, AL
- De Kalb, AL
- Catoosa, GA
- Chattooga, GA
- Dade, GA
- Gordon, GA
- Murray, GA
- Walker, GA
- Whitfield, GA
- Bledsoe, TN
- Bradley, TN
- Grundy, TN
- Hamilton, TN
- Marion, TN
- McMinn, TN
- Meigs, TN
- Polk, TN
- Rhea, TN
- Sequatchie, TN

BEA 50 (Segment): Knoxville, TN

- Anderson, TN
- Blount, TN
- Knox, TN
- Union, TN
- Loudon, TN
- Monroe, TN
- Roane, TN

BEA 54 (Segment): Louisville, KY

- Clark, IN
- Floyd, IN
- Bullit, KY
- Jefferson, KY
- Oldham, KY

BEA 62 (Segment): Cincinnati, OH

- Clermont, OH
- Hamilton, OH
- Warren, OH
- Dearborn, IN
- Ohio, IN
- Boone, KY
- Campbell, KY
- Kenton, KY
- Carroll, KY
- Gallatin, KY
- Grant, KY
- Owen, KY
- Switzerland, IN

BEA 66 (Segment): Pittsburgh, PA

- Allegheny, PA
- Beaver, PA
- Butler, PA
- Washington, PA
- Westmoreland, PA

BEA 115 (Segment): Paducah, KY

- Calloway, KY
- Graves, KY
- Livingston, KY
- Lyon, KY
- McCracken, KY
- Marshall, KY
- Trigg, KY
- Massac, IL
- Pope, IL

Source: Robert R. Nathan Associates, Inc.

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